Idaho State Department of Agriculture
Division of Agricultural Resources

Ground and Surface Water Quality of Northwest Gooding County
Water Quality Monitoring Results

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Introduction

Recent and historical ground water monitoring indicate that nitrate and bacteria has contaminated a shallow aquifer northwest of Bliss, Idaho (Figure 1). Past monitoring of a spring (Butler Spring) fed by this shallow aquifer has shown that elevated nitrate and bacteria levels have been present since at least 1994. The Twin Falls Office of the Division of Environmental Quality (DEQ) sampled and detected nitrate at various levels in the Butler Spring in October 1994 (11.1 milligrams per liter (mg/L)) and August 1995 (8.0 mg/L). The highest count of total coliform bacteria was 52 CFU/100 milliliters (ml) in October 1994. In July 1999, the Butler Spring again was sampled by DEQ and found to have nitrate at 18.5 mg/L. More recent monitoring of the spring in November 1999 by the Idaho State Department of Agriculture (ISDA) measured nitrate concentrations at 11.8 mg/L. Recent nitrate concentrations at the spring exceeded the EPA Maximum Contaminant Level (MCL) for drinking water of 10 mg/L.

Several potential (current and historical) sources for contamination of the shallow aquifer are in the general area. Immediately east of the Butler spring is a dairy operation (Bosma Dairy), which began operation in April 1995. Prior to this period, a cattle feeding operation was located at this dairy site for numerous years. Also to the east of the spring and covering much of the surrounding area are irrigated agricultural croplands, cattle grazing lands, and a number of rural homes. Another dairy operation (Wybenga Dairy) is at the eastern-most extent of the project area.

Purpose of the Project

The goals of this project are to further characterize the water quality of the area, determine source(s) of contaminants, and work to prevent further contamination. ISDA is coordinating efforts with the Idaho Department of Water Resources (IDWR), and DEQ to reach these goals. These agencies and residents in the area would like to determine relative contaminant contributions from the potential sources up gradient from the spring. The information will be used to make regulatory and voluntary changes to practices that are potentially contributing to the problem. ISDA is the lead water quality agency for this project.

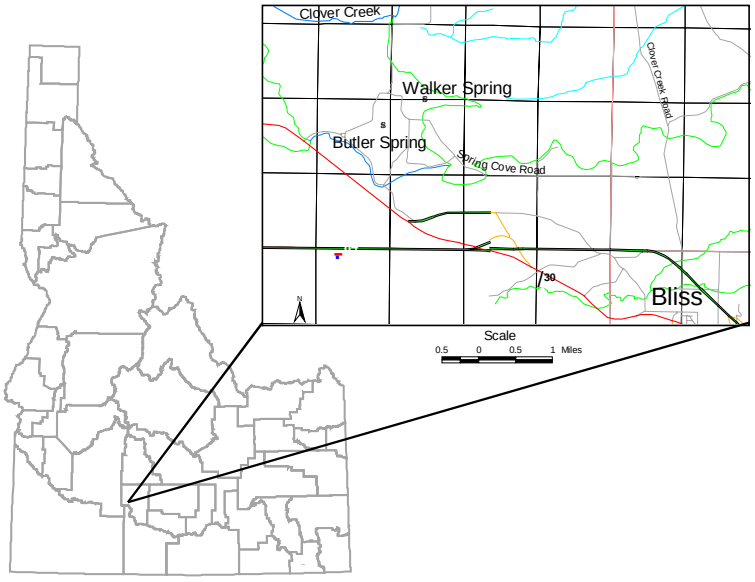

Figure 1. Northwest Gooding County project area.

Results

ISDA sampled and tested springs, canals, ponds, lagoons, ground water wells, and soils in the project area for a variety of parameters including nitrate, bacteria, and nitrogen isotopes. Quarterly monitoring was conducted in November 1999 and in February 2000. The Butler and Walker Springs have been sampled nearly every two weeks since November 1999. Monitoring is planned to continue through November 2000. Results of primarily November 1999 ISDA monitoring are presented in this summary.

Nitrate

For the initial monitoring event (November 1999), 16 wells, five surface water sites, and the Butler and Walker Springs were sampled and tested in the project area. Thirteen of the 16 wells showed positive detections for nitrate. The highest nitrate concentration determined from a well sample was 7.6 mg/L at a location in the central portion of the project area (Figure 2). The majority of nitrate concentrations found in sampled domestic wells were between 5.0 – 7.6

mg/L. There were no well samples with nitrate levels over the EPA MCL of 10 mg/L. Canal and pond sample sites showed negligible concentrations of nitrate.

From the first to second quarterly sampling, one well went up ~ 2 mg/L and one well went down ~ 2 mg/L. Three wells were not resampled due to various factors. Biweekly monitoring of the Butler Spring indicated a steady decline in nitrate concentrations. In November 1999, the Butler Spring was 11.8 mg/L for nitrate (Figure 2). The spring was at 10.5 mg/L for nitrate in early December 1999. The most recent nitrate concentration tested at the spring was 8.7 mg/L (March 16, 2000). In November 1999, the Walker Spring was 6.9 mg/L for nitrate and in February 2000 increased to 16.8 mg/L.

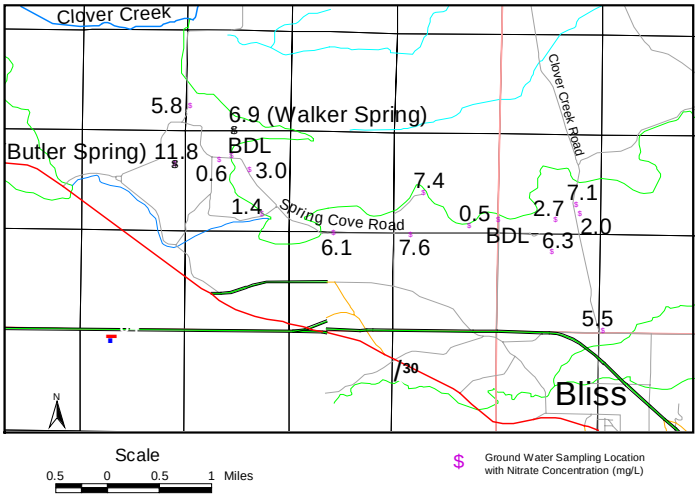

Figure 2. Nitrate concentrations in ground water from ISDA testing during November 1999.

Nitrogen Isotopes

Nitrogen isotopes are often useful in determining sources of nitrate. Common sources of nitrate entering ground water are from applied commercial fertilizers, animal or human waste, precipitation, or organic nitrogen within the soil. Each of these nitrate source categories has a distinguishable isotopic signature (i.e., $^{15}N/^{14}N$ ratio). Table 1 displays typical ratio values of $N^{15}/^{14}N$ for major sources of potential nitrogen contamination.

During the initial monitoring event (November 1999), ISDA collected samples from the two spring sites and five surface water sites for evaluation of nitrogen isotopes ($\delta^{15}N\text{-}NO_3$), oxygen isotopes ($\delta^{18}O$), and deuterium ($\delta^{2}H$). At the completion of this report, results of nitrogen isotope testing were the only ones available from the laboratory. Of the sites tested, only the Butler Spring, Bosma Lagoon, and Walker Spring had sufficient nitrate concentrations for nitrogen isotope analysis.

Table 1. Typical $\delta^{15}N\text{-}NO_3$ ranges for nitrogen sources.

Potential Contaminant Source	$\delta^{15}N\text{-}NO_3$ (o/oo)
Commercial Fertilizer	-4 to +4
Animal or human waste	Greater than +10
Precipitation	-3
Organic nitrogen in soil	+4 to +9

(Seiler, R.L., 1996, Methods for identifying sources of nitrogen contamination of ground water in valleys in Washoe County, Nevada: U.S. Geological Survey Open-File Report 96-461, 20 p.)

Nitrogen isotope testing of Butler Spring water returned a $\delta^{15}N\text{-}NO_3$ value of 3.7 (o/oo), which is within the range of –4 to + 4 for commercial fertilizer as reported by Seiler (1996) (Table 2). At the Walker Spring, in November 1999, the $\delta^{15}N\text{-}NO_3$ result was 5.7 o/oo falling within an organic nitrogen range as indicated by Seiler (1996) (Table 2). The Walker Spring $\delta^{15}N\text{-}NO_3$ result could be influenced by the environmental conditions present at the sampling site where there is open water flowing over soil, vegetative debri, and possible historical wildlife and domestic animal waste.

The nitrogen isotope test from the November 1999 sampling of the Bosma Dairy, lined lagoon returned a $\delta^{15}N\text{-}NO_3$ value of 16.7 o/oo. This value is indicative of an animal or human waste signature and falls 6.7 o/oo above the minimum level of 10 o/oo reported by Seiler (1996) (Table 2).

Table 2. N^{15} isotope results from the November 2-3 & 18, 1999 sampling event.

Sampling Location	Sampling Date	NO_3-N (mg/L)	$\delta^{15}N\text{-}NO_3$ (o/oo)
Bosma Lagoon	11/2/99	6.9	16.7
Butler Spring	11/2/99	9.9	3.7
Walker Spring	11/2/99	5.5	5.7
Faulkner Pond	11/2/99	0.2	NM*
Y-8 Canal	11/2/99	<0.1	NM*
y-8 Downstream	11/18/99	<0.1	NM*
Northside Canal	11/2/99	<0.1	NM*

NM* = Not Measured (tested but not able to measure).

Bacteria

November 1999, bacteria results indicate little bacterial contamination in ground water wells in the project area. A sampled well ~ 2.5 miles east of the Butler Spring had an elevated total coliform detection. This could be a reflection of the piping system and infrequent use. A domestic and livestock well located ~ 0.5 miles northwest of Walker Spring also had a detection of total coliform.

The canal system, Faulkner Pond, Walker Spring, and the Bosma Dairy lagoon all had bacterial detections.

The Butler Spring had no detections of bacteria in November 1999. However, the Butler Spring is routinely chlorinated, which places some doubt on testing results from specific sampling events. The Walker Spring had counts of 900/100 ml for total coliform, 50/100 ml for e-coliform, and 24/100 ml for fecal coliform bacteria.

Ground Water Flow

Horizontal ground water flow directions in the project area were determined for the shallow aquifer by measuring static water levels in shallow wells of the project in late November 1999. Static water level measurements were used to determine ground water elevations that were subsequently contoured to develop a shallow aquifer ground water flow map (Figure 3).

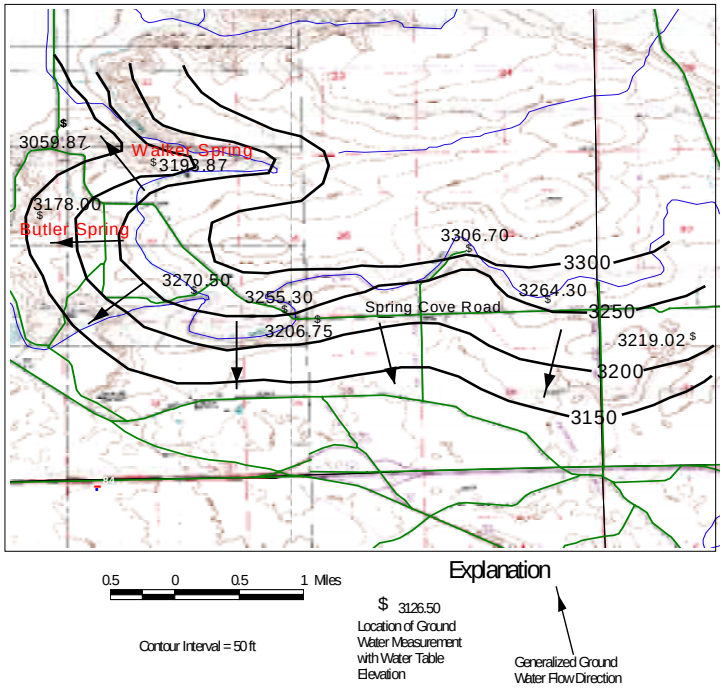

Figure 3. Water table contour map of shallow aquifer.

Results of this analysis indicate that general ground water flow is to the west in the vicinity of the Butler Spring. Results also indicate ground water flow directions tend to mimic the grade of local topography. In general, ground water flow in the central and eastern portions of the project area is to the south.

Conclusions

Wells and springs in the project area were elevated in nitrate, but canal and pond waters were not. Of the samples taken in November 2000, the Butler Spring had the highest concentration of nitrate (11.8 mg/L). However, shallow wells sampled as part of this project and the Walker Spring had nitrate concentrations greater than 5 mg/L. Wells having less than 5mg/L nitrate were comparatively deeper.

On November 2, 1999, the Butler Spring $\delta^{15}N\text{-}NO_3$ laboratory result of 3.7 o/oo suggests the major source of nitrate to be from commercial fertilizer. Based on the general ground water flow direction, it is likely that the source(s) of nitrate contamination to the Butler Spring is somewhere from the east within the project area. However, determination of contaminant sources in the project area will require further monitoring and evaluation. Implementation of the project is scheduled to continue for a complete year (Nov. 1999 - Oct. 2000).

Quarterly sampling will continue to take place at the various surface and ground water sampling sites. The Butler and Walker Springs will be sampled on a bi-weekly basis. Additional samples will be taken every two weeks at the springs and at select wells quarterly for possible isotope testing. These tests will further assist in determining sources of nitrate contamination. Depth to ground water measurements will be taken in the middle of the irrigation season, and a new ground water flow map will be created by ISDA. ISDA, in partnership with DEQ and IDWR, will continue to conduct further assessment of all water quality, quantity, and soils data collected. ISDA will continue to work with producers and land owners in the area to implement the project.

Recommendations

ISDA recommends a variety of actions to be taken by landowners, producers, and agencies to prevent further contamination of the aquifer in the project area. The ISDA recommends that:

- Agricultural producers in the area with irrigation systems conduct nutrient, and irrigation water management evaluations. Agency staff from at least ISDA and possibly other agencies can assist with these efforts.
- Producers follow the Natural Resources Conservation Service (NRCS) Nutrient Management Standard (590).
- Dairy and nondairy livestock operation continue to manage animal waste in a manner not to impact ground water. Ground water protection measures are necessary when storing, handling, hauling, and applying animal waste. For technical assistance, ISDA Technical Services Engineers and certified nutrient management planners can assist.

ISDA will continue to follow the monitoring plan and implement this project for one full year to try and determine source(s) of contamination to waters within the project area.